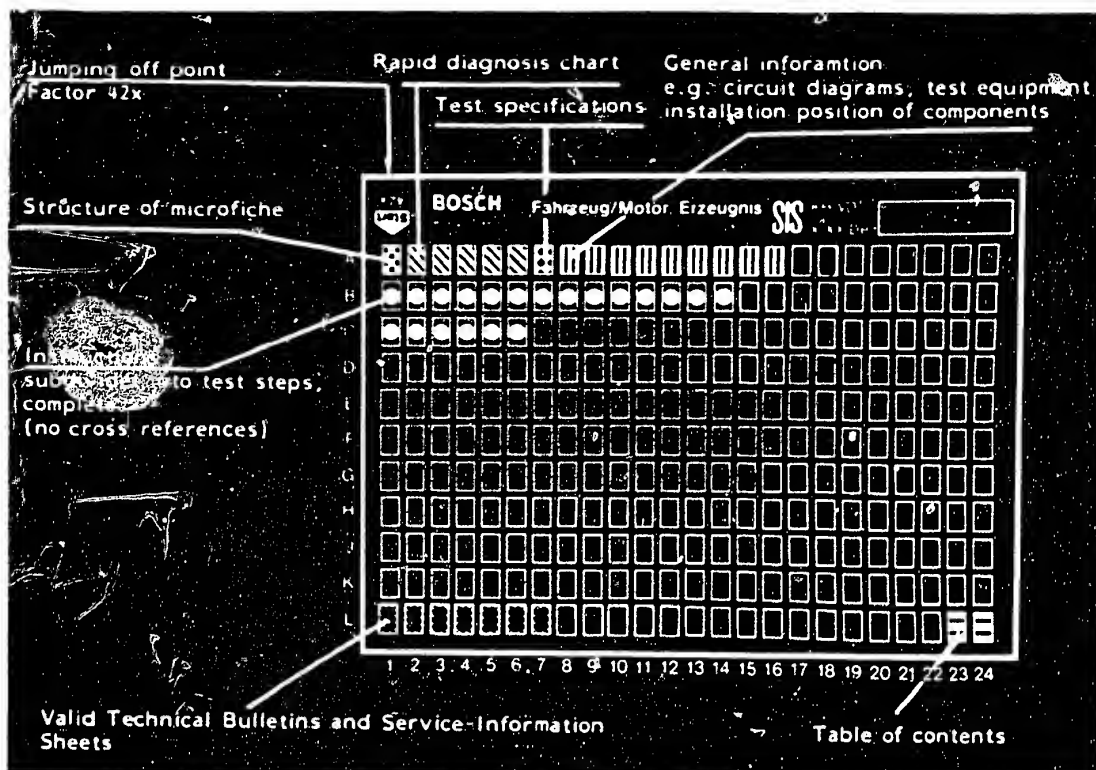


## Structure of microfiche



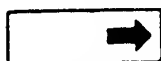
1. Read from left to right

2. Title of microfiche (appears on each coordinate)

<b>E 16</b>	Product/assembly/test step	
	Vehicle/engine	

Coordinate

3. Limits of section



Beginning



Mid-section



End



One-page section

4. References to relevant test steps in test specifications; coordinate e.g. C6

**C 6**

**A1**

Trouble-shooting program



## 1. Rapid diagnosis chart

The following rapid diagnosis chart makes it possible for the experienced expert to quickly check the electrical/electronic part of the ignition system using normal workshop test equipment.

The rapid diagnosis chart contains the following information:

- Customer complaint
- Cause of the trouble
- Test instructions (if no coordinate given on the right, further possibilities for testing are indicated).
- Coordinates for detailed trouble-shooting.

If detailed information and instructions on trouble-shooting are necessary, always proceed according to the trouble-shooting program starting on Coordinate B 1.



# Rapid diagnosis chart

Customer complaint (symptom of trouble)

1. Starting motor operates, but engine fails to start
2. Rough idling
3. Poor throttle response
4. Engine lacks power
5. Misfiring
6. Fuel consumption too high
7. Engine pings when accelerating
8. Backfiring
9. Engine becomes too hot

									<u>Cause of trouble</u>	<u>Testing instructions</u>	<u>Coordinate</u>
●	●	●	●	●	●		●		Spark plugs defective	Assess using ignition oscillogram or remove spark plug and make visual examination.	---
●	●	●	●	●	●	●	●	●	Ignition timing incorrect	See Autodata test specifications	---
●	●	●	●	●					Shunt on secondary side	Assess ignition coil, ignition distributor, ignition harness and spark plug using ignition oscillogram or make visual examination	---
●	●	●	●	●					Open circuit on secondary side	Assess ignition coil, ignition distributor, ignition harness and spark plug using ignition oscillogram, or test for continuity using ohmmeter	---
●									Open circuit on primary side	Test voltage supply to trigger box or test primary circuit	C 3
●	●	●	●	●					Ignition coil defective	Visual examination, electrical test	B 5

**A3**

Rapid diagnosis chart

Porsche



**A4**

Rapid diagnosis chart

Porsche



# Rapid diagnosis chart

Customer complaint (symptom of trouble)

1. Starting motor operates, but engine fails to start

2. Rough idling

3. Poor throttle response

4. Engine lacks power

5. Misfiring

6. Fuel consumption too high

7. Engine pings when accelerating

8. Backfiring

9. Engine becomes too hot

									<u>Cause of trouble</u>	<u>Testing instructions</u>	<u>Coordinate</u>
		●	●	●	●				Interference-suppression resistors defective	Assess using ignition oscillogram or perform resistance measurement	---
	●	●	●		●	●	●	●	Centrifugal advance defective	See Autodata test specifications	---
		●	●		●	●		●	Vacuum advance defective	See Autodata test specifications	---
●									Trigger box defective	Test trigger box output stage, test primary voltage	B 13 B 15
●									Ignition distributor pulse generator defective	Test resistance and short circuit to ground of coil section. Check pulse generator for mechanical damage.	C 1
●	●	●	●	●					Engine-speed limiter defective	Test cut-out speed, or perform visual examination	---
●									Firing sequence incorrect	See Autodata test specifications	---

**A5**

Rapid diagnosis chart

Porsche



**A6**

Rapid diagnosis chart

Porsche



## 2. Test specifications

Ignition coil primary	1.0...1.7 $\Omega$	<b>B5</b>
Ignition coil secondary	5.5...10.0 k $\Omega$	
Ballast resistor (resistance cable)	0.9...1.1 $\Omega$	

Voltage drop ignition coil with ignition on	$\sim 3.4$ V at $U_B$ $\sim 11$ V	<b>B7</b>
Voltage supply trigger box with ignition on	max. 1.0 V below $U_B$	

Dwell angle at $n = 1500 \pm 50 \text{ min}^{-1}$ $n = 5000 \pm 50 \text{ min}^{-1}$	49-77° (55-85%) 67-83° (75-92%)	<b>B11</b>

Trigger box output stage with ignition on	max. 2 V	<b>B13</b>

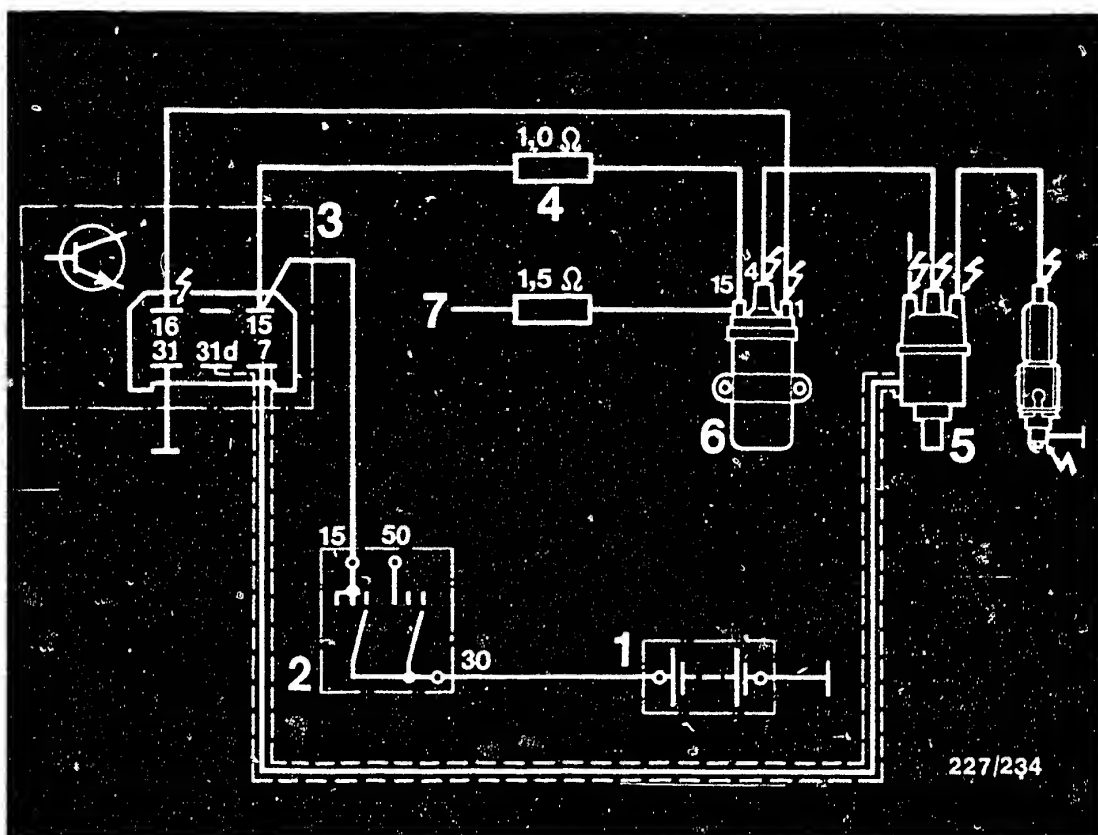
Primary voltage with engine idling	290...370 V	<b>B15</b>

Resistance of coil section	470...820 $\Omega$	<b>C1</b>

Short circuit to ground of coil section	$R = \infty$	
--	--------------	--

See Autodata test specifications for setting values for ignition, idle speed, exhaust gas, valve clearance etc.

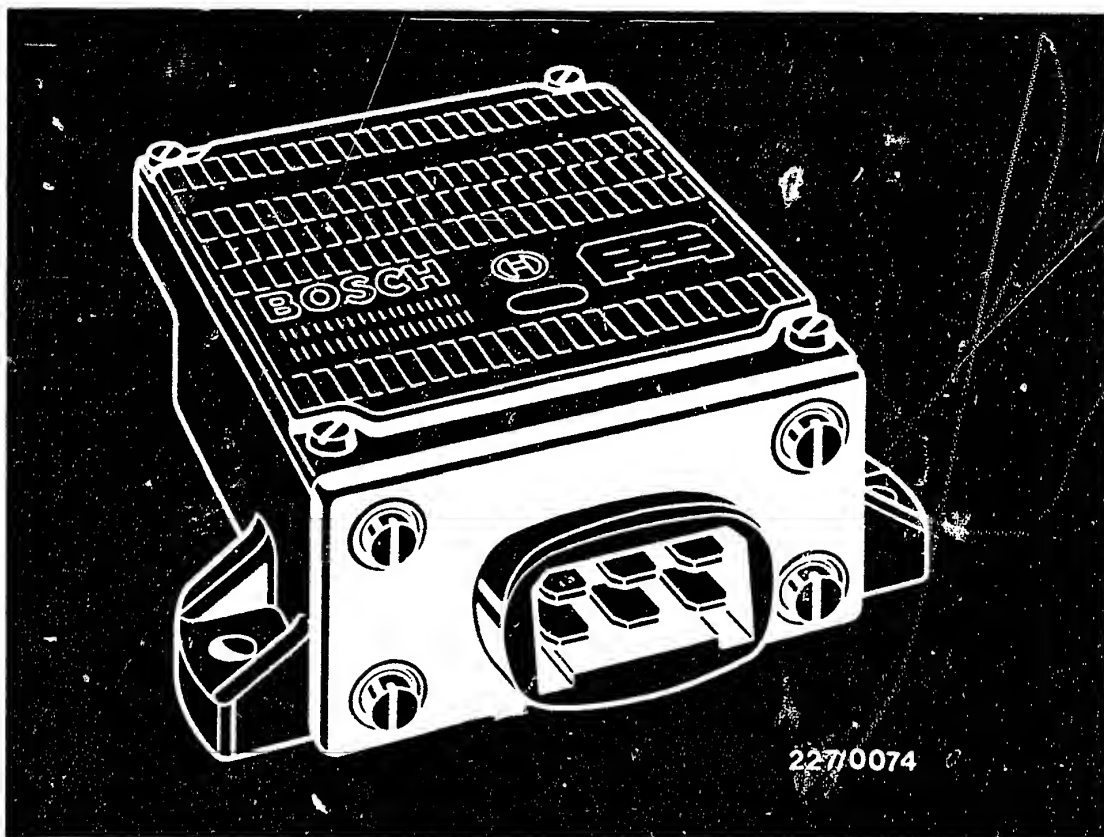




- 1 = Battery
- 2 = Ignition and starting switch
- 3 = Trigger box
- 4 = Resistance cable
- 5 = Ignition distributor
- 6 = Ignition coil
- 7 = Resistance cable to starting motor term. 15 a

⚡ = Dangerous voltages (400 V - 25 kV)

### 3. Electrical terminal diagram



TCI trigger box

#### 4. Installation position of components

The trigger box is situated in the engine compartment on the wheel housing on the left-hand side as viewed in the forward direction of travel.



## 5. Necessary test equipment and aids

Motortester e.g.	MOT 201	0 684 000 201
Spark gap e.g. ignition coil and condenser tester or	EFAW 106A	0 681 100 001
Single spark gap	EF 1177/7	1 684 531 000
5 kΩ sleeve-type suppressor		0 356 500 001
Ohmmeter or e.g.	ETE 014.00 Pontavi Wh2	0 684 101 400 Commercially available
Voltmeter e.g.	ETE 014.00	0 684 101 400
Test prods		Commercially available





## 6 Danger of accident on electronic ignition systems

Increased demands of modern engines on the ignition system combined with the desire for freedom of maintenance have recently led to electronic ignition systems being fitted as standard. Usually the ignition power of electronic systems (of almost all manufacturers) is higher than that of conventional systems, and there are signs of further increases in power. Electronic ignition systems thus reach a power range which can be highly dangerous if live parts or terminals are touched (both on the primary as well as the secondary sides).

In this connection we should like to point out that the VDE regulations, in particular VDE 0104/7.67 and/or the respective national regulations must be followed when testing or working on the ignition system.

The ignition should always be switched off when working on the ignition system (switch off ignition or voltage source). Such work includes:

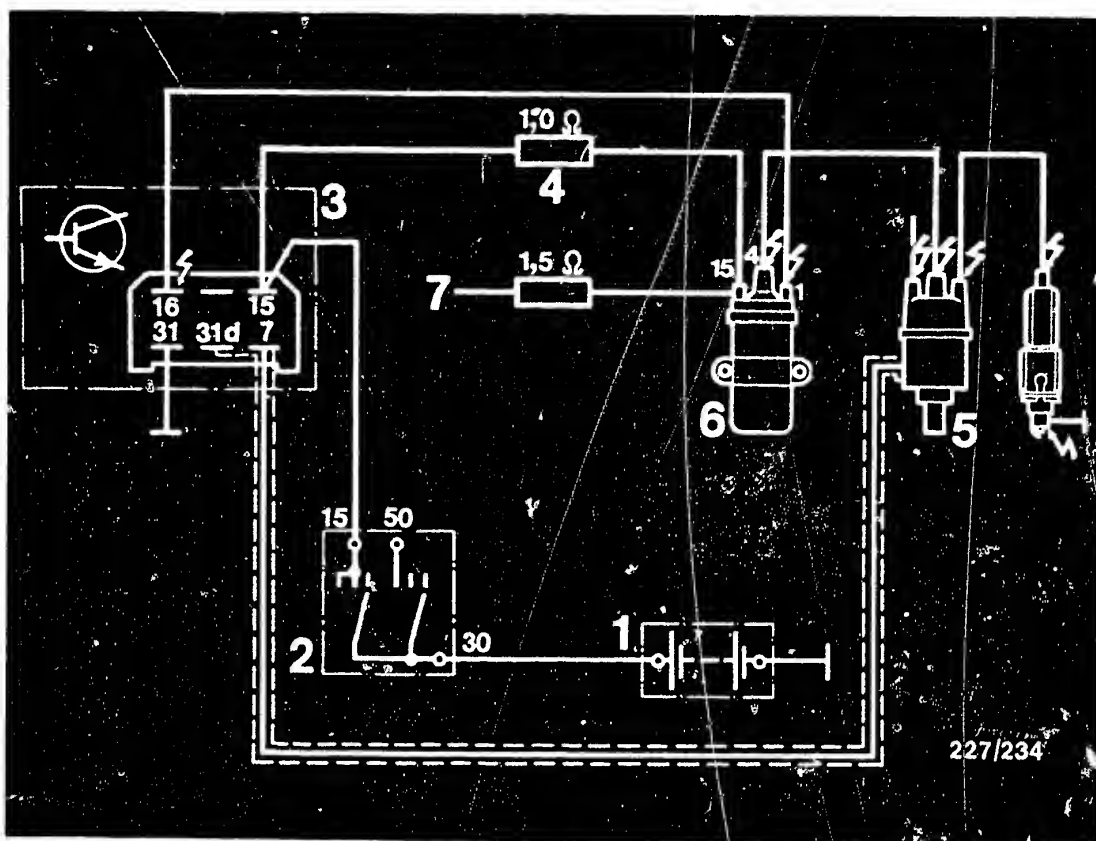
- Connecting of engine test equipment (timing light, dwell-tach tester, ignition oscilloscope, etc).
- Replacing parts of the ignition system (spark plug, ignition coil, ignition distributor, H.T. ignition cable, etc).



If, while testing the ignition system or during adjustment work on the engine (e.g. carburettor), it becomes necessary to switch on the ignition (switch on ignition or voltage source), the above-mentioned dangerous voltages occur over the entire system.

The danger of accident exists, therefore, not only on the individual assemblies of the ignition system (e.g. ignition distributor, ignition coil, trigger box, ignition harness), but also on the wiring harness (e.g. tachometer connection, diagnostic plug), at plug-in connections and test equipment.





- 1 = Battery
- 2 = Ignition and starting switch
- 3 = Trigger box
- 4 = Resistance cable
- 5 = Ignition distributor
- 6 = Ignition coil
- 7 = Resistance cable to starting motor term. 15 a

⚡ = Dangerous voltages (400 V - 25 kV)

### Electrical terminal diagram

The dangerous locations are marked with danger arrows taking the example of the terminal diagram of an electronic ignition system.

## 7. Important vehicle information

- The voltage increase for starting is by means of a 1.5  $\Omega$  resistance cable connected in parallel to term. 15 of the ignition coil.

$$(R_{\text{tot}} = \frac{R_1 \times R_2}{R_1 + R_2} = \frac{1 \times 1.5}{1 + 1.5} = 0.6 \Omega)$$

### Caution:

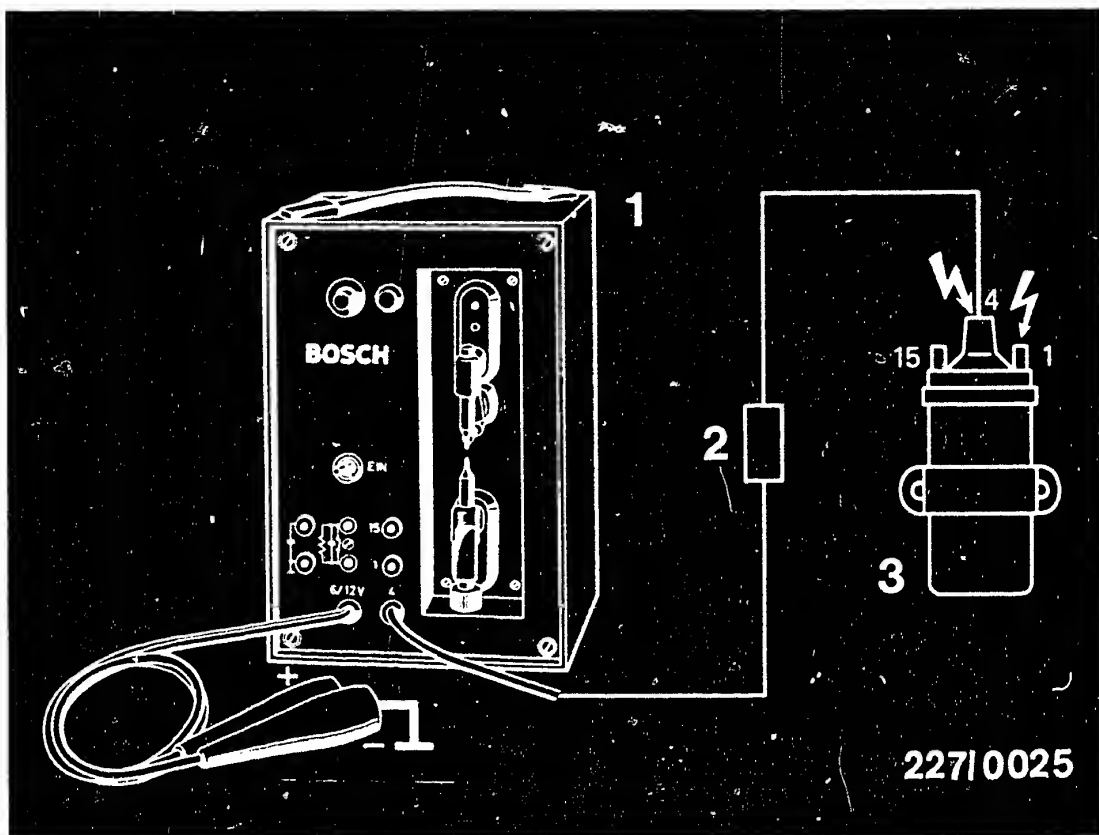
The resistance cables must not be shortened when carrying out repair work.

- During the compression test, either pull off the trigger-box plug or firmly connect terminal 4 of the ignition coil to ground using an extra cable (dangerous voltages, insulation damage at ignition coil, ignition distributor, ignition harness).

Note: The extra cable must be suppressed with at least 2 k $\Omega$ , e.g. with sleeve-type suppressor (5 k $\Omega$ ) 0 356 500 001.

- Resistance measurements must only be performed with the ignition switched off or with the battery disconnected (measuring instrument defective).
- In order to prevent the trigger box from being irreparably damaged, the secondary side of the ignition system must have at least 2 k $\Omega$  interference suppression.





- 1 = Spark gap
- 2 = 5 kΩ sleeve-type suppressor
- 3 = Ignition coil

⚡ = Dangerous voltages (400 V - 25 kV)

- In order to prevent the trigger box from being irreparably damaged, when using a spark gap, an interference-suppression resistor of at least 2 kΩ must be connected between the spark gap and ignition coil terminal 4, e.g. sleeve-type suppressor (5 kΩ) 0 356 500 001.
- In the case of ignition distributors with engine-speed limiter the ignition distributor side term. 4 must have 1 kΩ interference suppression. Operation without interference suppression will lead to the destruction of the trigger box.

- The holding springs of the distributor cap must not drop into the pulse generator system when the engine is being cranked and with the dust-protection cover removed.
- Do not disconnect the battery while the engine is running.
- Incorrect battery polarity will lead to the destruction of the trigger box and ignition coil.
- Do not use a starting aid with more than 16 V or a fast charger for starting.
- The specified ignition coil (see Part No.) must not be replaced with a different ignition coil.
- No suppression capacitor must be connected to ignition coil terminal 1 and terminal 15.
- No battery + and no test lamp may be connected to ignition coil term. 1 (trigger box will be destroyed).
- Ignition cable from ignition coil term. 4 to ignition distributor term. 4 must not be disconnected during operation.
- The line between the induction-type pulse generator and the trigger box must be screened (otherwise negative effect on operation of trigger box).



## 8. Trouble-shooting program

### Procedure

The trouble-shooting program is divided into 3 rows of boxes.

The left-hand row contains test instructions and test specifications.

The center row contains repair instructions.

The right-hand row contains the illustrations/terminal diagrams belonging to the text and the explanation of the items in the picture.

If the questions asked in the left-hand row can be answered conclusively with "yes", then proceed to the next test down.

If the answer to the question is "no", branch to the center row and carry out the tests given there.

Before testing, make sure of the following:

Battery fully charged, fuel system O.K., engine mechanically O.K. (e.g. compression, valve clearance etc). Ambient temperature/ignition system temperature 0° to +100°C (temperature has a considerable effect on measured values).



Beginning of trouble-shooting program

Starting motor operates, engine fails  
to start or misfires or lacks power.

Yes

Continued on B 3





Yes

Test primary signal. If no oscilloscope or tachometer is available, check whether there is an ignition spark across the spark gap.

Primary signal with oscilloscope  
Connect oscilloscope to ignition coil as per operating instructions. Start the engine. Oscilloscope must show a primary voltage (of any value).

Primary signal with tachometer  
Connect tachometer to ignition coil as per operating instructions. Start the engine. Tachometer must indicate a value (any value).

Ignition spark with spark gap  
Disconnect ignition cable term. 4 from ignition coil. Connect spark gap including sleeve-type suppressor (5 k $\Omega$ ) to ignition coil. Adjust spark gap to 5 mm. Start the engine. There must be sparks across the spark gap.

Primary signal present or ignition sparks across spark gap?

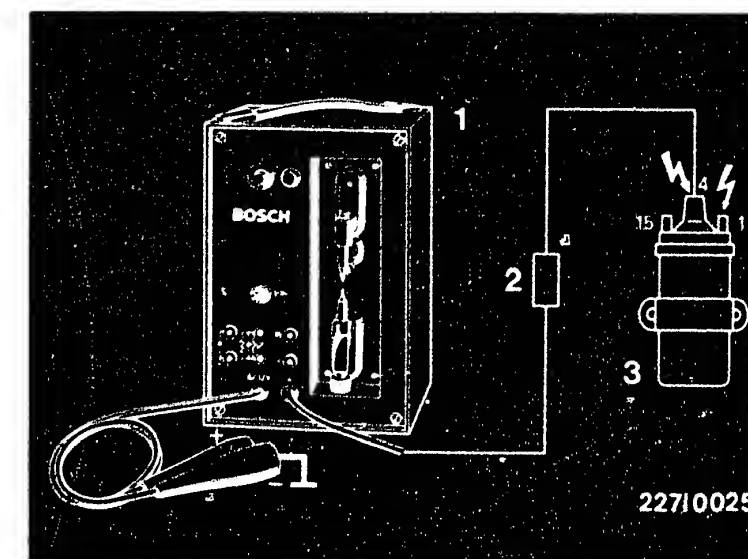
Yes

Continued on B5/B6

No

If no primary signal or no ignition spark, continue testing at C 1.

Tests as from B 5 not necessary.



**B3**

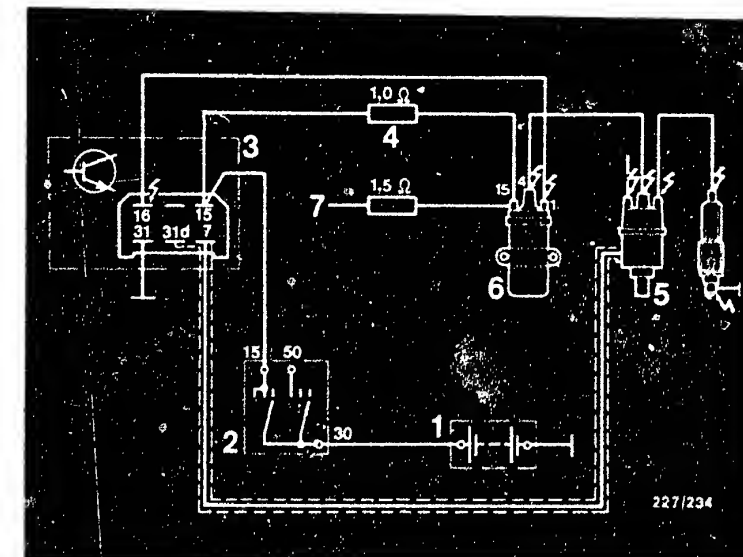
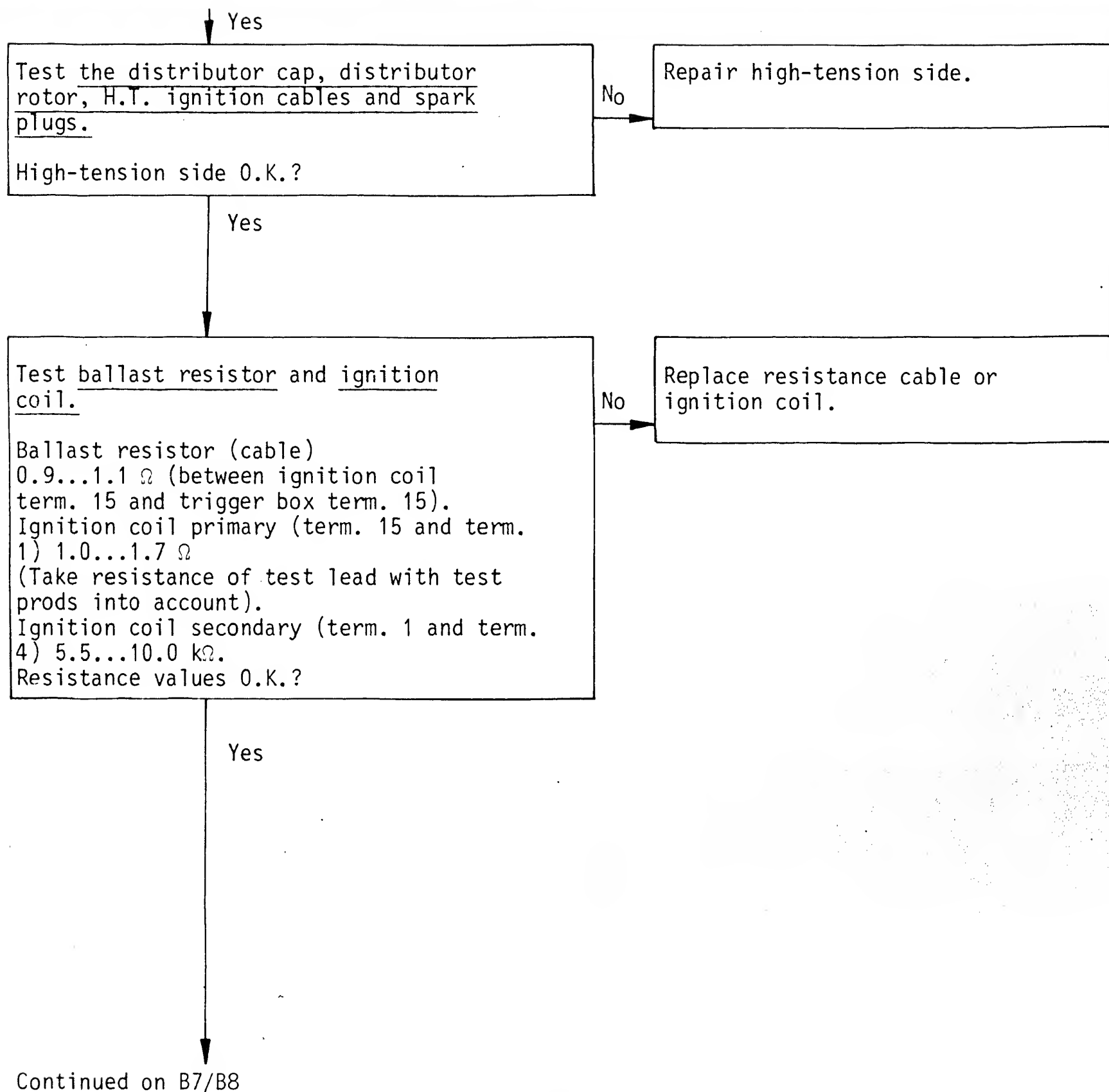
Trouble-shooting program  
Porsche



**B4**

Trouble-shooting program  
Porsche



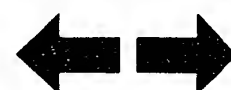


- 1 = Battery
- 2 = Ignition and starting switch
- 3 = Trigger box
- 4 = Resistance cable
- 5 = Ignition distributor
- 6 = Ignition coil
- 7 = Resistance cable to starting motor term. 15 a

⚡ = Dangerous voltages  
(400 V - 25 kV)

**B5**

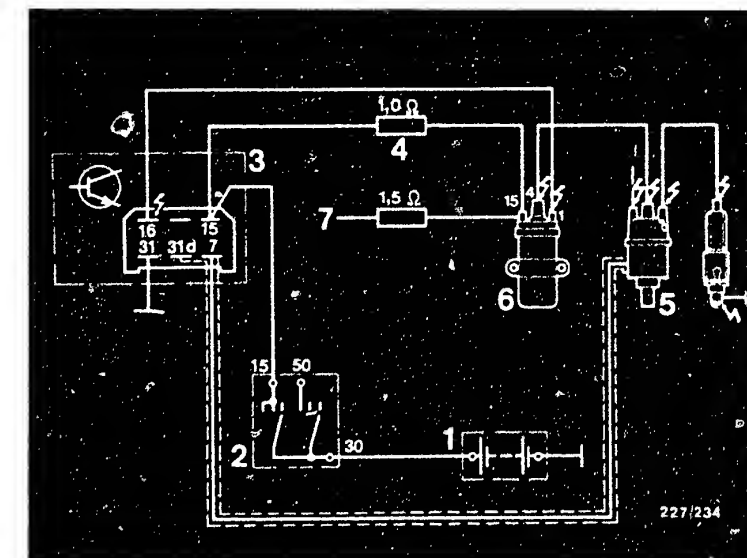
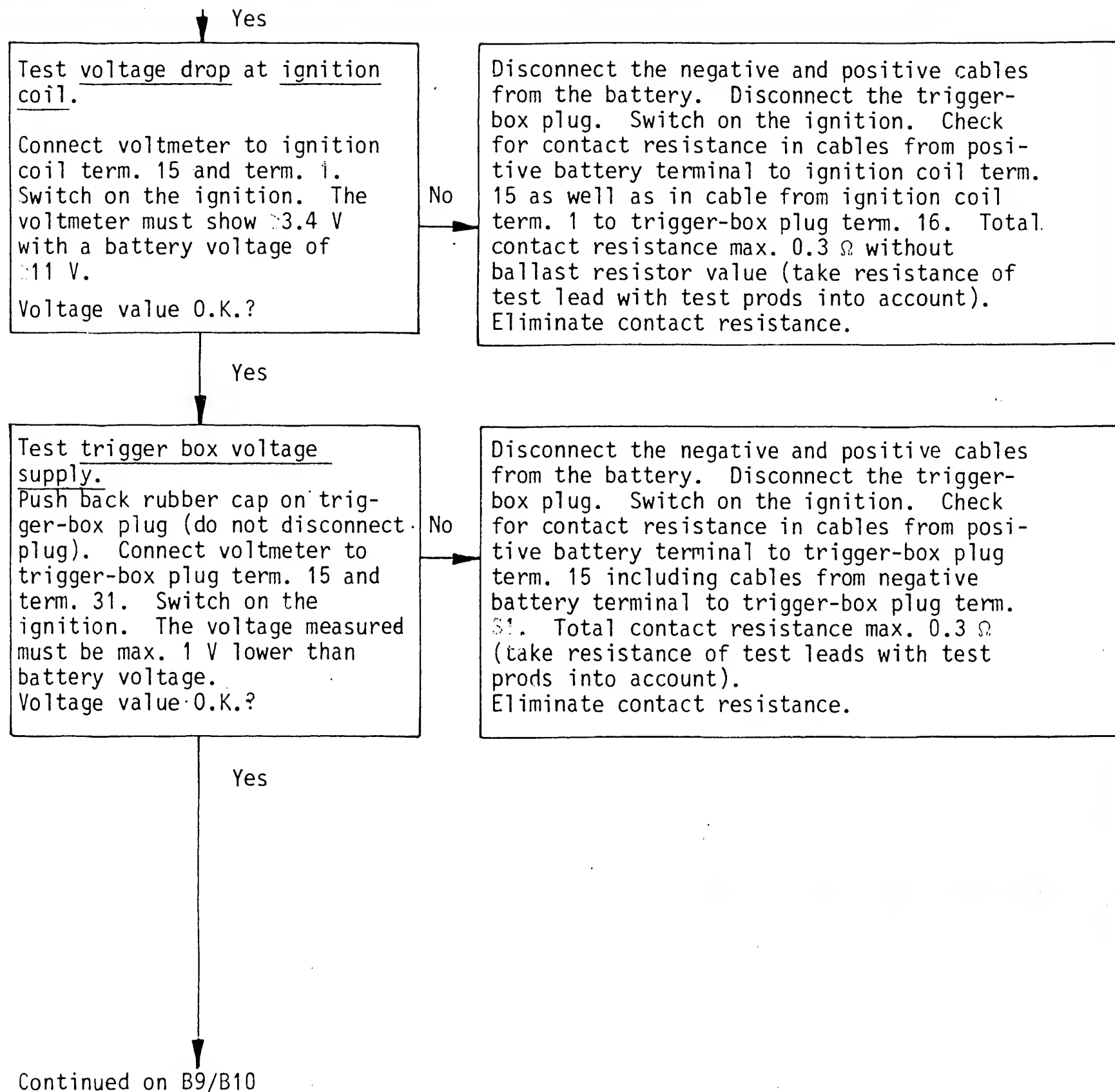
Trouble-shooting program  
Porsche



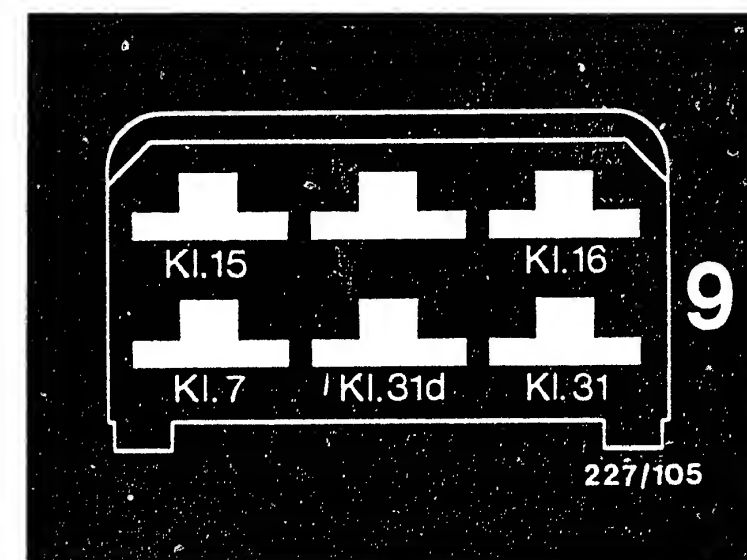
**B6**

Trouble-shooting program  
Porsche





- 1 = Battery
- 2 = Ignition and starting switch
- 3 = Trigger box
- 4 = Resistance cable
- 5 = Ignition distributor
- 6 = Ignition coil
- 7 = Resistance cable to starting motor term. 15 a
- ⚡ = Dangerous voltages (400 V - 25 kV)
- 9 = Trigger-box plug



**B7**

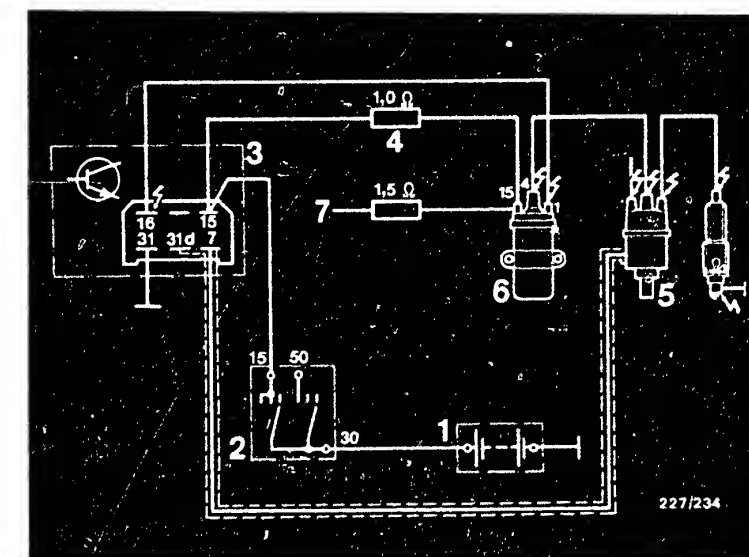
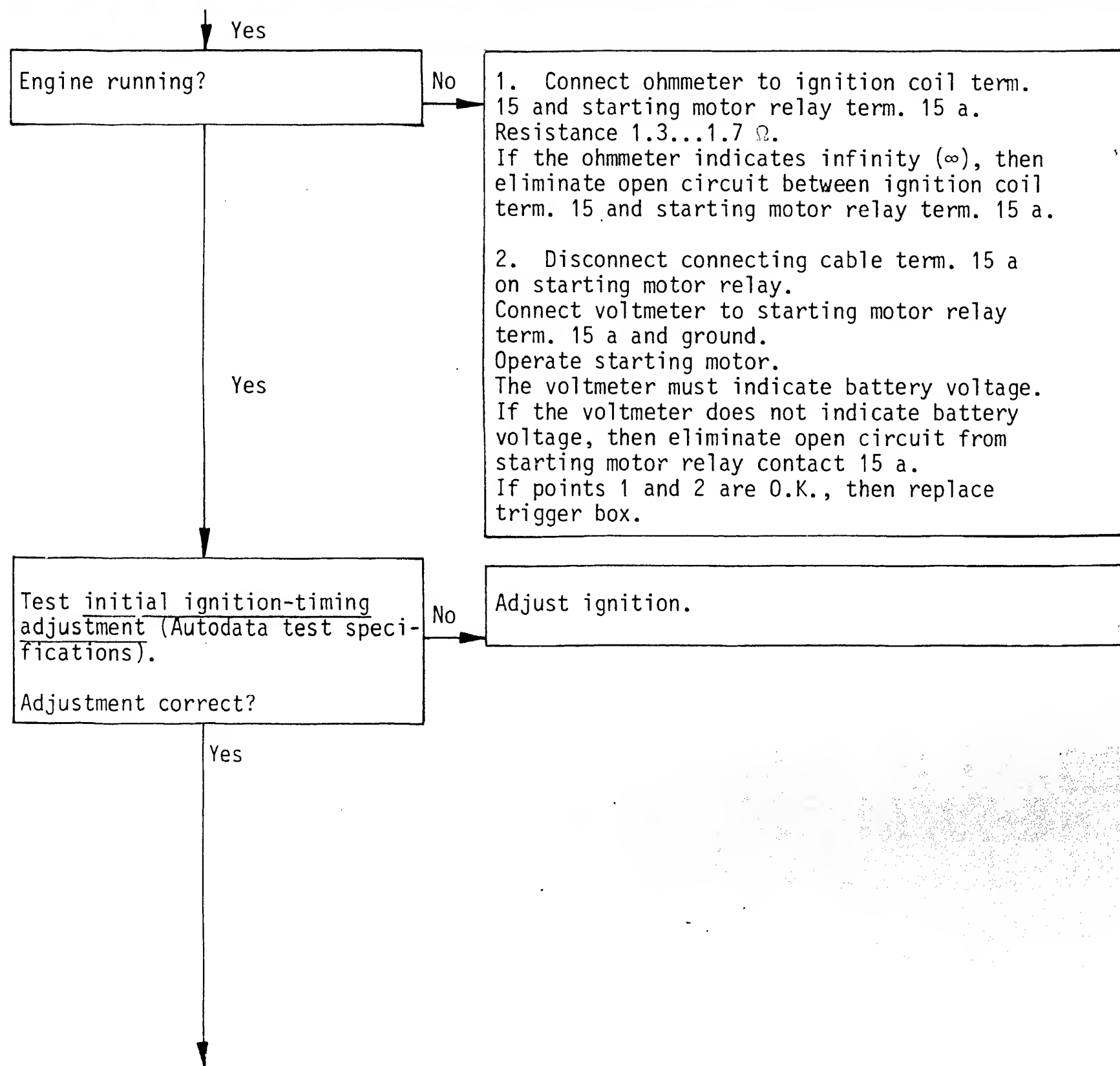
Trouble-shooting program  
Porsche



**B8**

Trouble-shooting program  
Porsche





- 1 = Battery
- 2 = Ignition and starting switch
- 3 = Trigger box
- 4 = Resistance cable
- 5 = Ignition distributor
- 6 = Ignition coil
- 7 = Resistance cable to starting motor term. 15 a

⚡ = Dangerous voltages (400 V - 25 kV)

Continued on B11/B12

**B9**

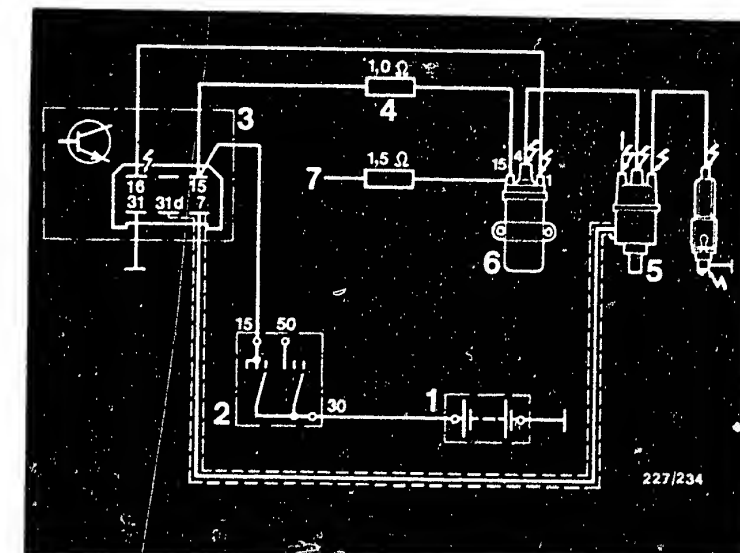
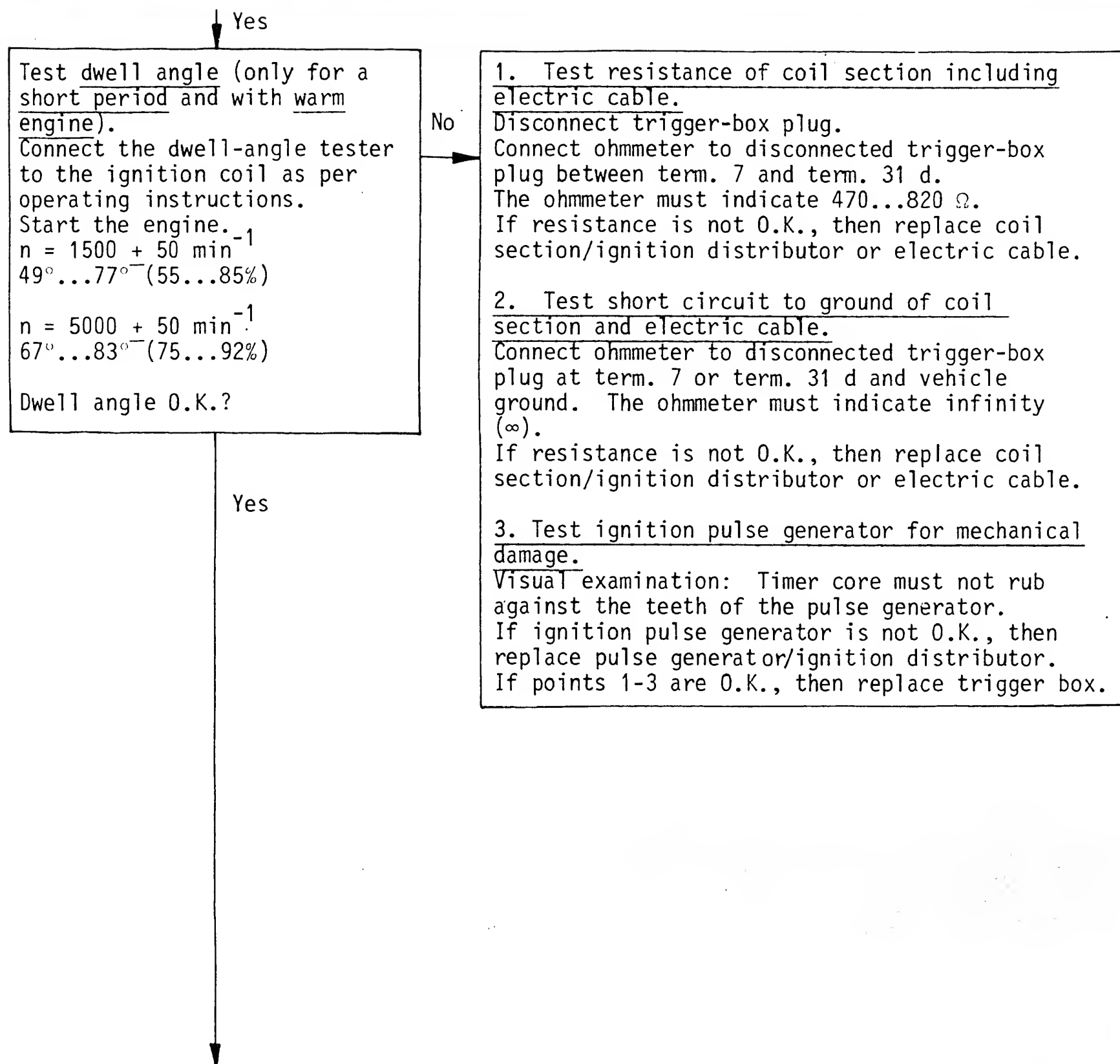
Trouble-shooting program  
Porsche



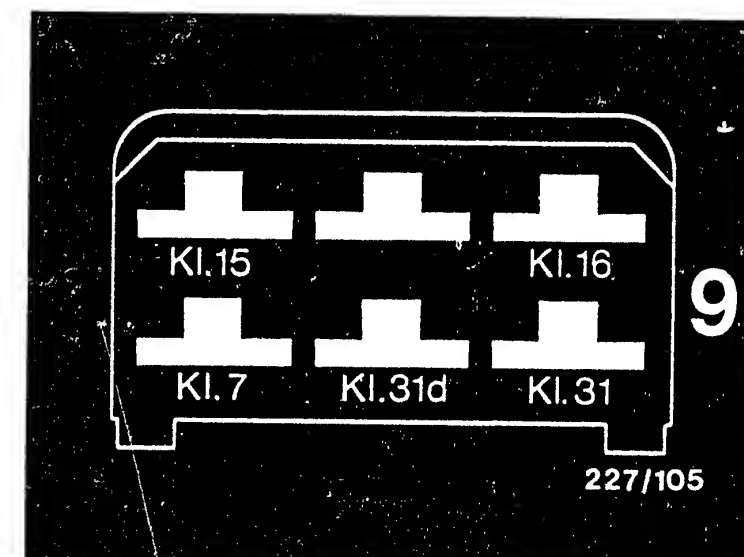
**B10**

Trouble-shooting program  
Porsche





- 1 = Battery
- 2 = Ignition and starting switch
- 3 = Trigger box
- 4 = Resistance cable
- 5 = Ignition distributor
- 6 = Ignition coil
- 7 = Resistance cable to starting motor term. 15 a
- ⚡ = Dangerous voltages (400 V - 25 kV)
- 9 = Trigger-box plug



**B 11**

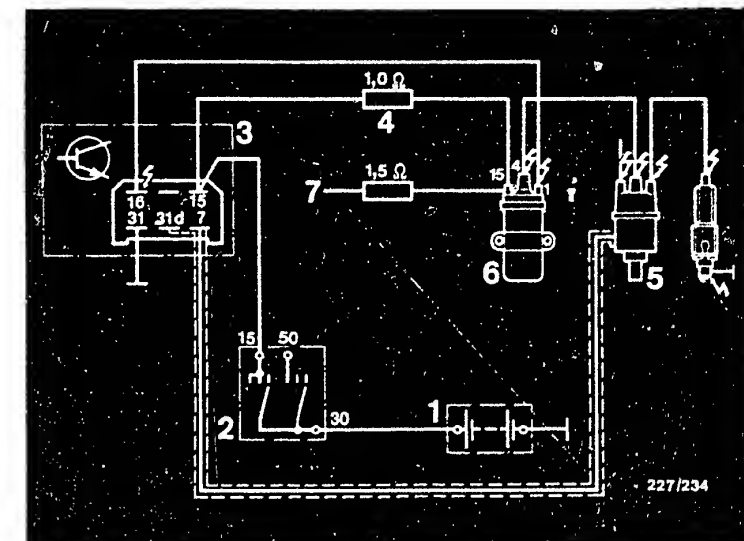
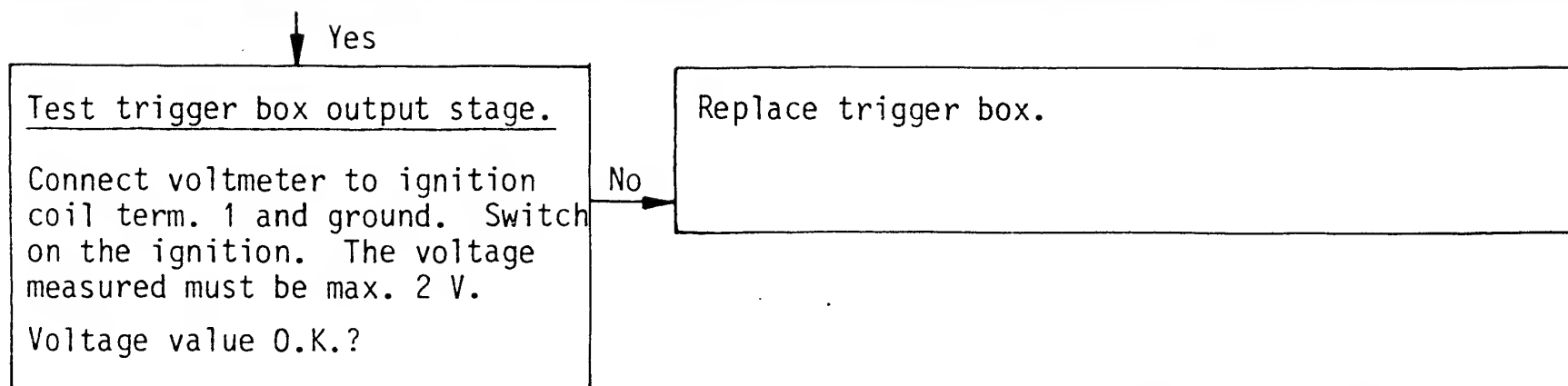
Trouble-shooting program  
Porsche



**B 12**

Trouble-shooting program  
Porsche





- 1 = Battery
- 2 = Ignition and starting switch
- 3 = Trigger box
- 4 = Resistance cable
- 5 = Ignition distributor
- 6 = Ignition coil
- 7 = Resistance cable to starting motor term. 15 a.

⚡ = Dangerous voltages  
(400 V - 25 kV)

Continued on B15/B16

**B 13**

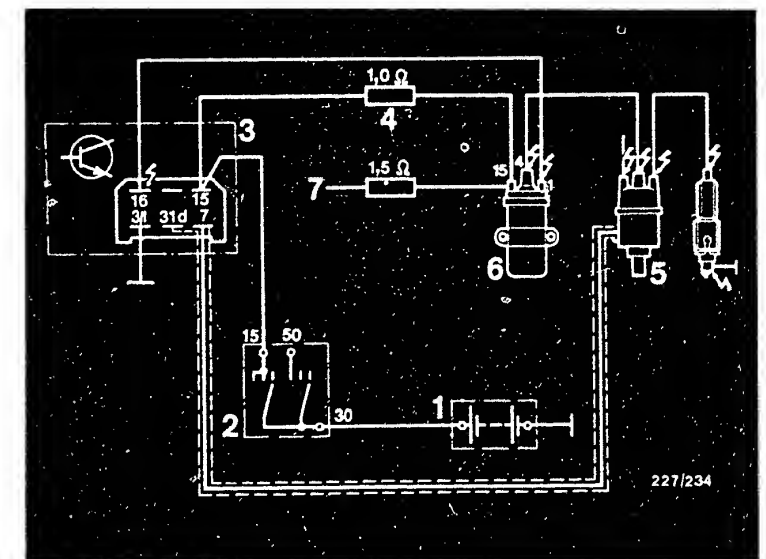
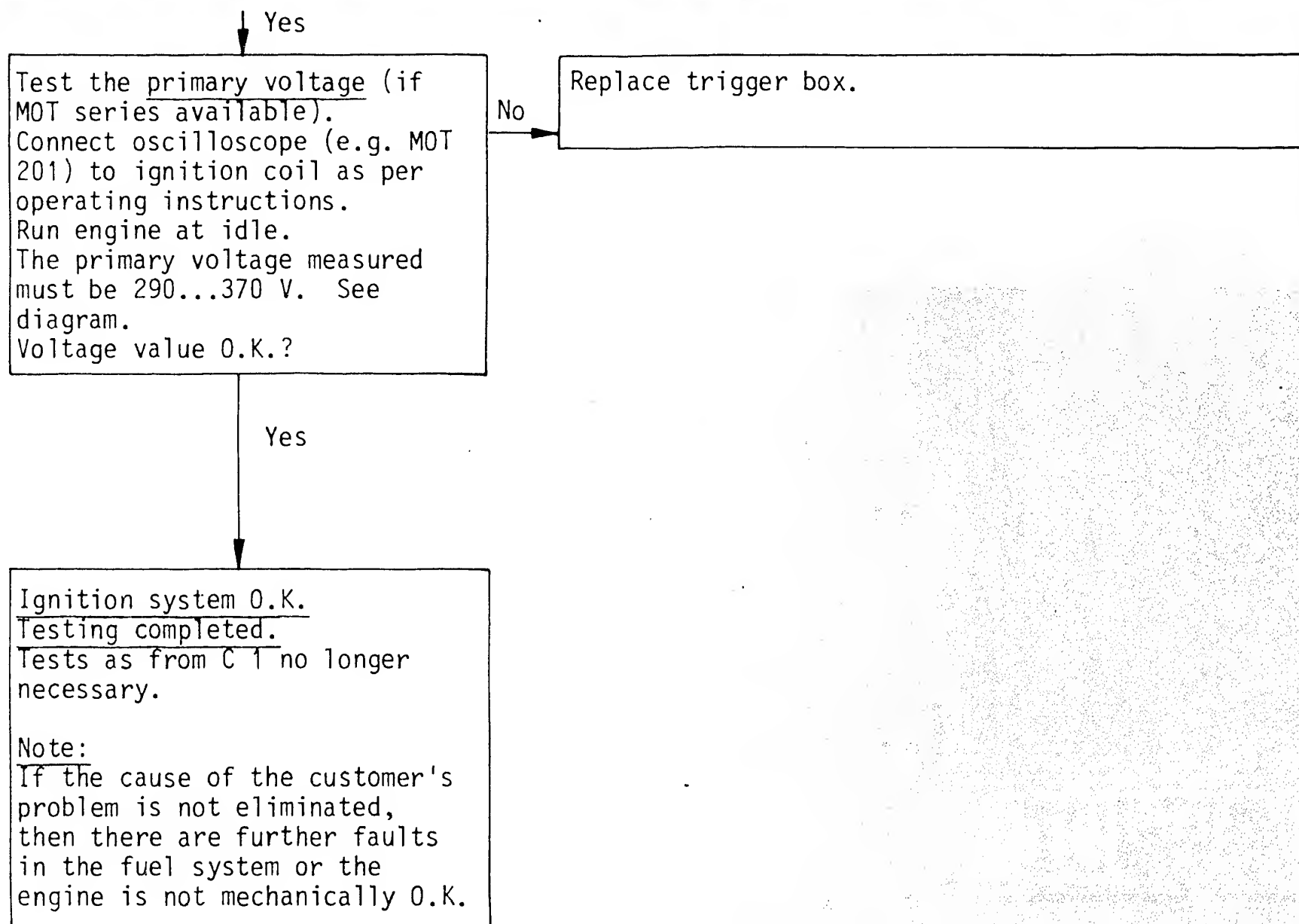
Trouble-shooting program  
Porsche



**B 14**

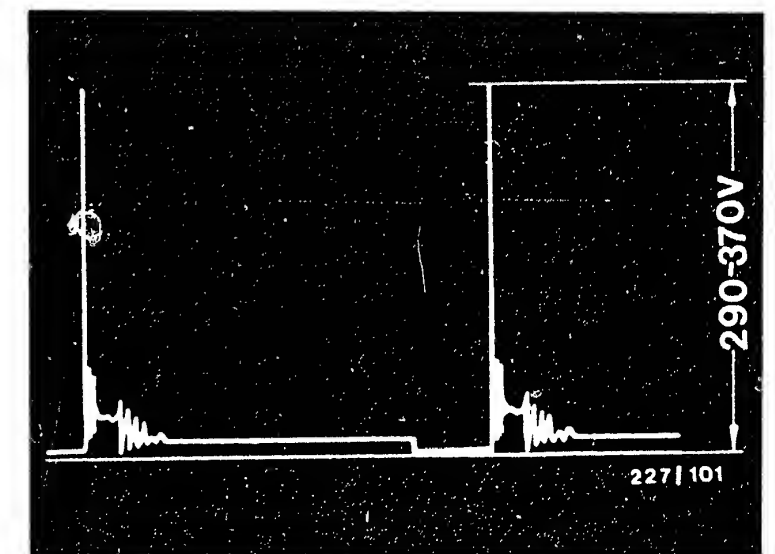
Trouble-shooting program  
Porsche





- 1 = Battery
- 2 = Ignition and starting switch
- 3 = Trigger box
- 4 = Resistance cable
- 5 = Ignition distributor
- 6 = Ignition coil
- 7 = Resistance cable to starting motor term. 15 a

⚡ = Dangerous voltages  
(400 V - 25 kV)



**B 15**

Trouble-shooting program  
Porsche



**B 16**

Trouble-shooting program  
Porsche





No primary signal or no ignition spark.  
(Continued from B 3)

Yes

Test resistance of coil section including electric cable.  
Disconnect trigger-box plug. Connect ohmmeter to disconnected trigger-box plug between term. 7 and term. 31 d. The ohmmeter must indicate 470...820  $\Omega$ . Resistance O.K.?

No

Replace coil section/ignition distributor or electric cable.

Yes

Test short circuit to ground of coil section and electric cable.  
Connect ohmmeter to disconnected trigger-box plug at term. 7 or term. 31 d and vehicle ground. The ohmmeter must indicate infinity ( $\infty$ ). Resistance ( $\infty$ ) O.K.?

No

Replace coil section/ignition distributor or electric cable.

Yes

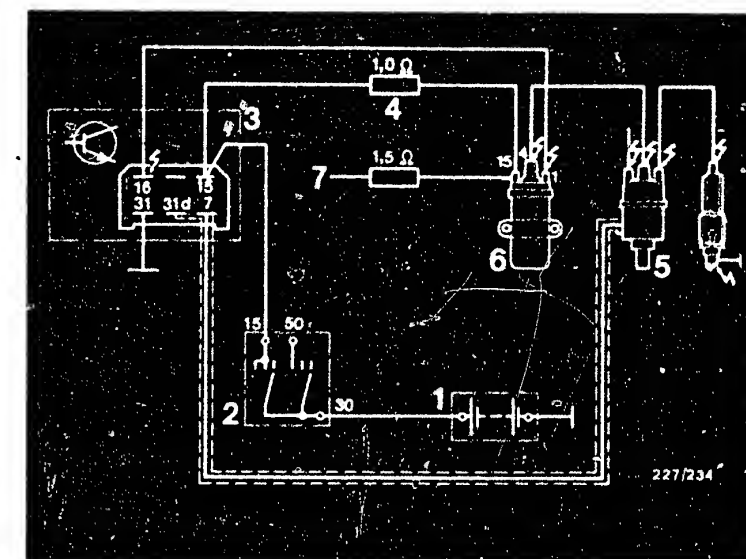
Test ignition pulse generator for mechanical damage.  
Visual examination: Timer core must not rub against the teeth of the pulse generator. Pulse generator O.K.?

No

Replace ignition pulse generator/ignition distributor.

Yes

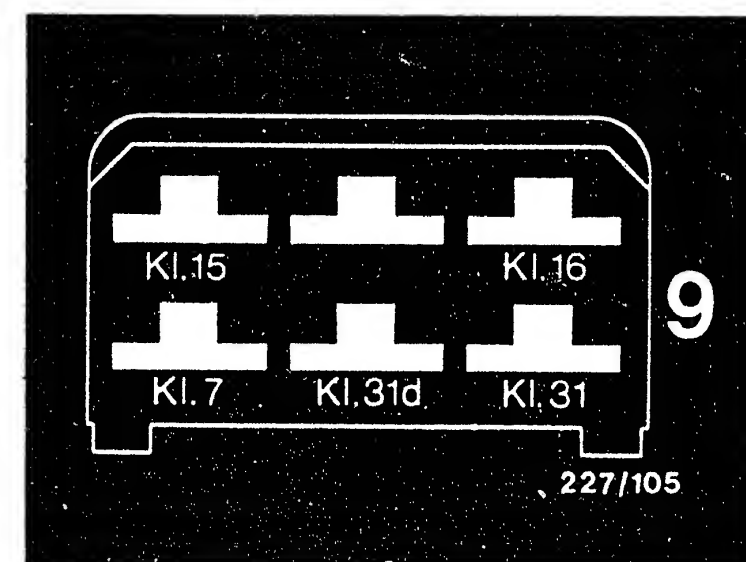
Continued on C3/C4



- 1 = Battery
- 2 = Ignition and starting switch
- 3 = Trigger box
- 4 = Resistance cable
- 5 = Ignition distributor
- 6 = Ignition coil
- 7 = Resistance cable to starting motor term. 15 a

⚡ = Dangerous voltages  
(400 V - 25 kV)

9 = Trigger-box plug



C1

Trouble-shooting program  
Porsche

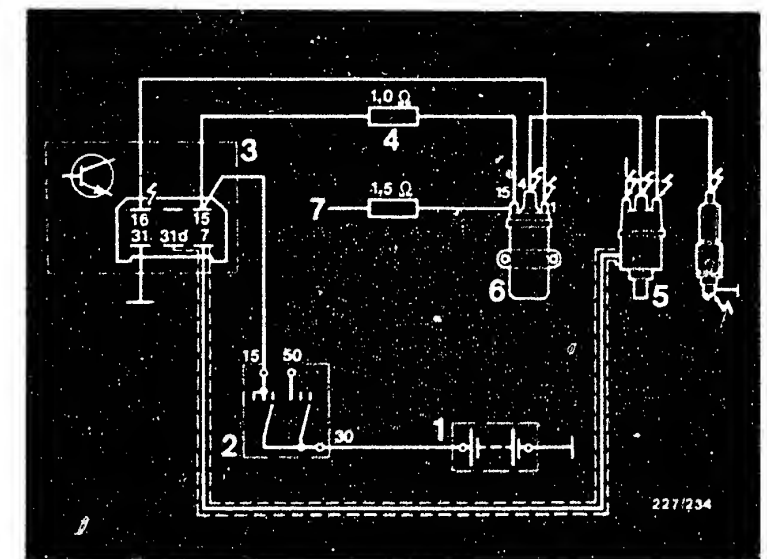
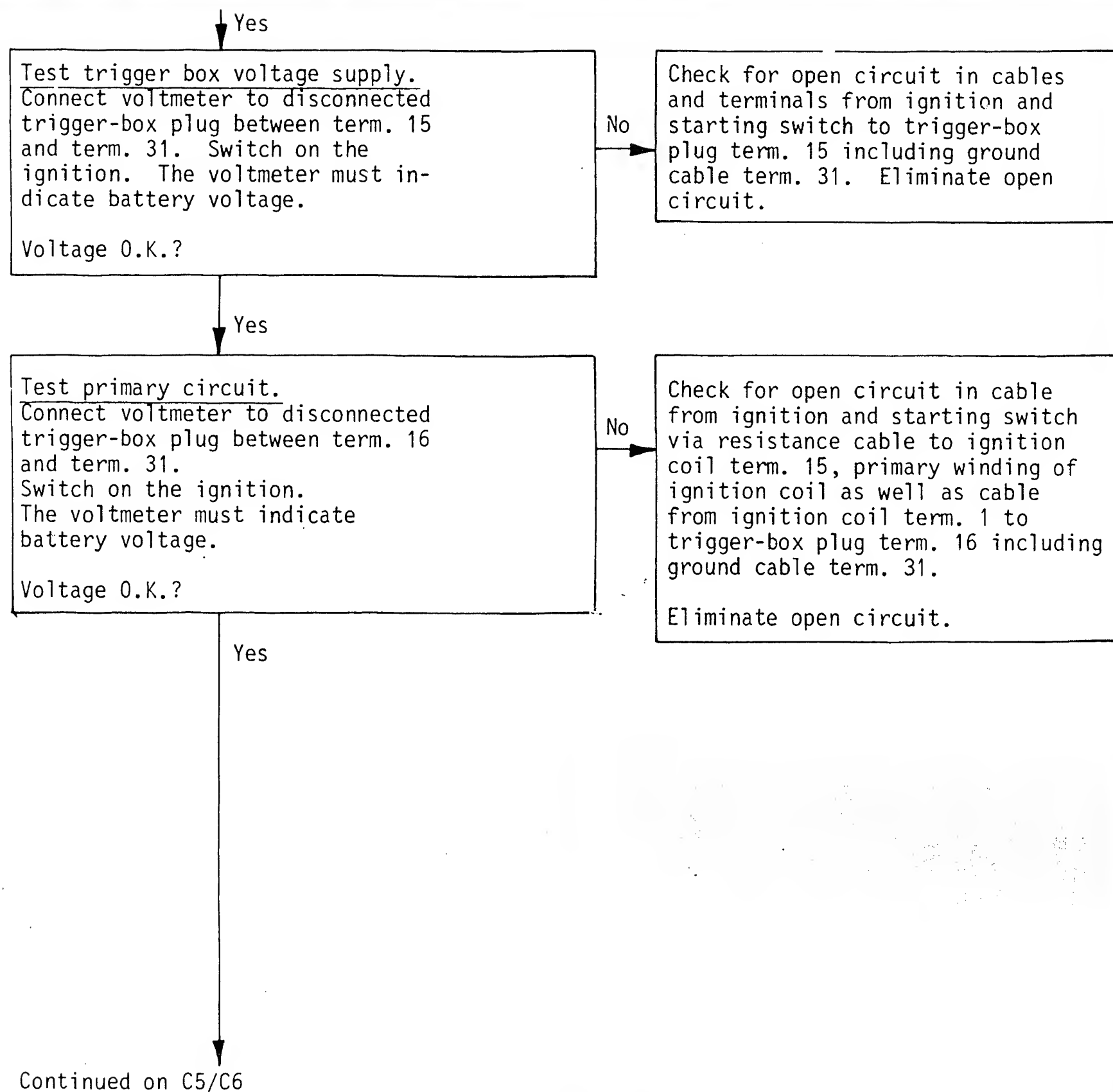


C2

Trouble-shooting program  
Porsche



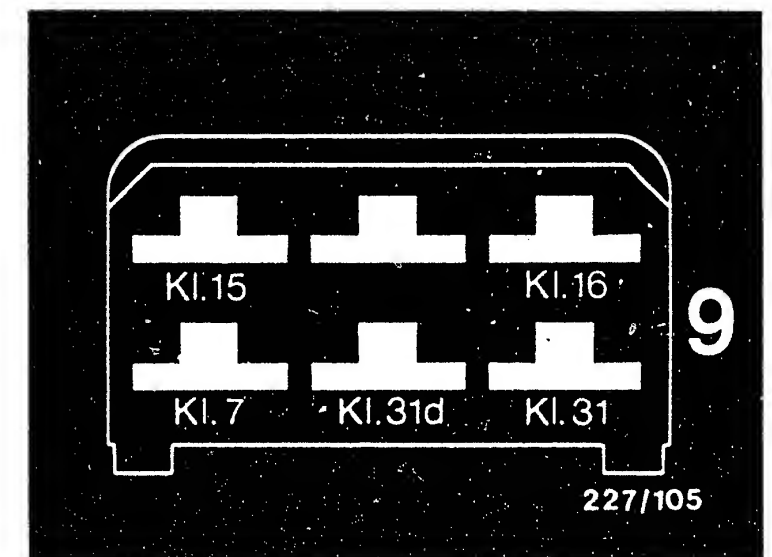




- 1 = Battery
- 2 = Ignition and starting switch
- 3 = Trigger box
- 4 = Resistance cable
- 5 = Ignition distributor
- 6 = Ignition coil
- 7 = Resistance cable to starting motor term. 15 a

⚡ = Dangerous voltages  
(400 V - 25 kV)

9 = Trigger-box plug



**C3**

Trouble-shooting program  
Porsche



**C4**

Trouble-shooting program  
Porsche



↓ Yes

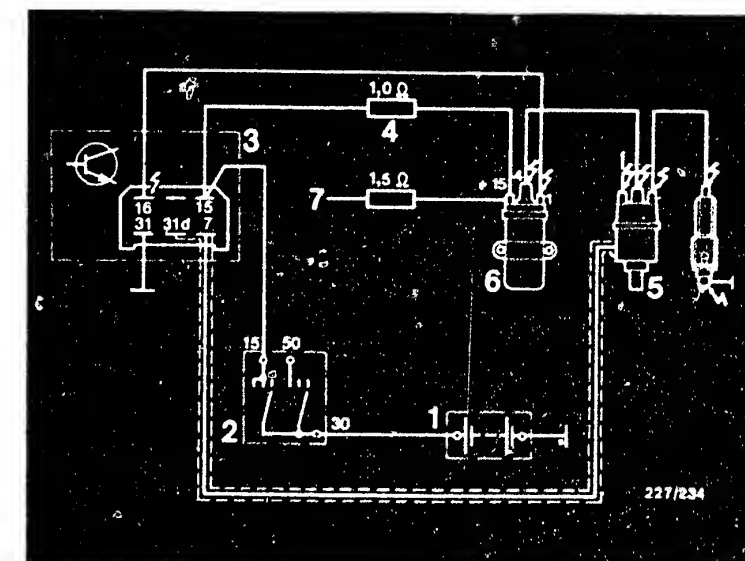
Test ballast resistor and ignition coil.  
 Ballast resistor (cable)  
 0.9...1.1  $\Omega$  (between ignition coil  
 term. 15 and trigger box term. 15).  
 Ignition coil primary (term. 15 and  
 term. 1) 1.0...1.7  $\Omega$   
 (Take resistance of test lead with  
 test prods into account).  
 Ignition coil secondary (term. 1 and  
 term. 4) 5.5...10.0 k $\Omega$   
 Resistance values O.K.?

No

Replace resistance cable or  
 ignition coil.

↓ Yes

Replace trigger box.  
 Testing completed.  
 Tests as from B 5 not necessary.  
 Note:  
 If the cause of the customer's problem  
 is not eliminated, then there are  
 further faults in the fuel system or  
 the engine is not mechanically O.K.



- 1 = Battery
- 2 = Ignition and starting switch
- 3 = Trigger box
- 4 = Resistance cable
- 5 = Ignition distributor
- 6 = Ignition coil
- 7 = Resistance cable to starting motor term. 15 a
- ⚡ = Dangerous voltages (400 V - 25 kV)

C5

Trouble-shooting program  
 Porsche



C6

Trouble-shooting program  
 Porsche



# After-sales Service

## Technical Bulletin

Only for use within the Bosch organization. Not to be communicated to any third party.

22

Danger of Accident on Semi-conductor Ignition Systems

VDT-I-227/102 B

11.1976

Please be sure to pass this bulletin on to your employees for their attention.

The increased demands made on their ignition systems by modern engines, and the wish for freedom from maintenance, led some time ago to manufactures starting to equip their vehicles with semi-conductor ignition systems as original equipment. In most cases the performance of nearly all makes of such systems is higher than that of conventional systems, and further improvements are to be expected. This means that semi-conductor ignition systems have reached the point where contact with "live" parts or contacts (whether on the primary side or the secondary side) can prove fatal.

In this connection we should like to point out to you that the laws valid in your country regarding work on high-voltage systems must be adhered to when working on, or testing, semi-conductor ignition systems.

As a matter of principle, when working on such ignition systems the ignition is to be switched off. Included in such work are the following operations:

- Connection of engine testing equipment (timing light, dwell-tooth tester, ignition oscilloscope etc.).
- Replacement of ignition system parts (spark plugs, ignition coil, ignition distributor, H.T. ignition cables etc.).

If it is necessary to switch on the ignition in order to test the system or make adjustments on the engine (to the carburetor for instance), then lethal voltages are present throughout the entire system.

This means that the danger of accident exists not only at individual components in the system (e.g. ignition distributor, ignition coil, trigger box, ignition harness), but also at the wiring harness (e.g. connection for the tachometer, diagnostic connector), on terminals, and on test equipment.

**BOSCH**

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L1

Technical Bulletin

Porsche

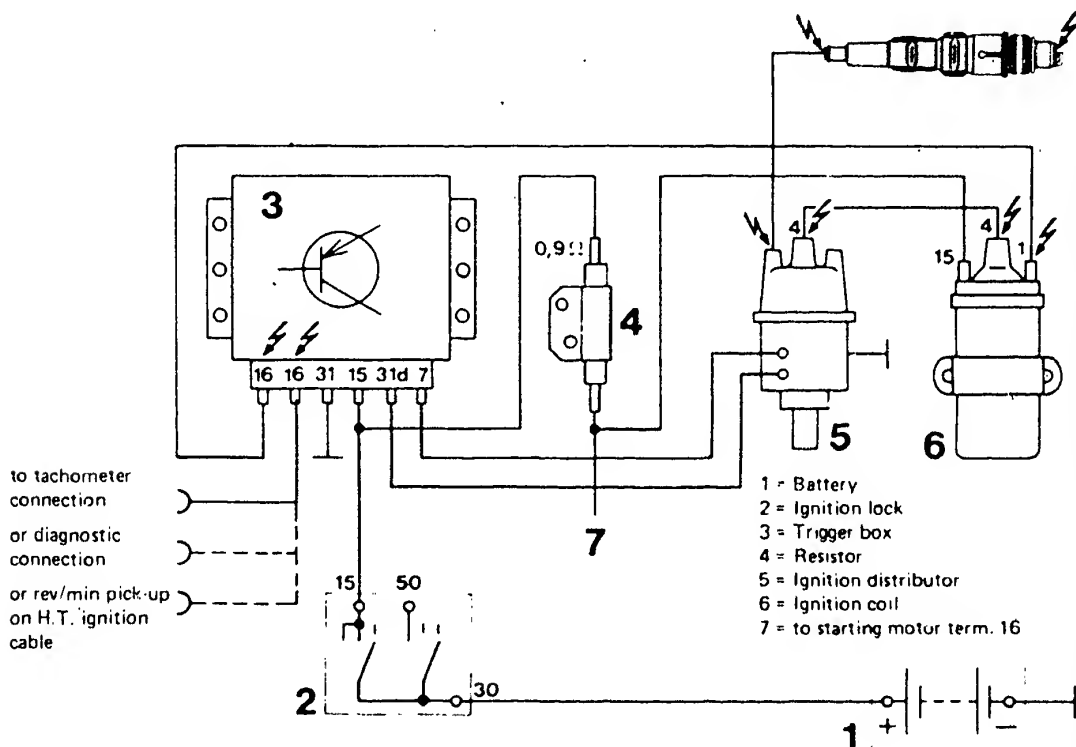


In addition, in the case of the capacitor-discharge ignition system (CDI), danger of accident is also present under the following circumstances:

- Operation of the trigger box without the ignition transformer.
- At the trigger box, (removed), relatively soon after it has been switched off (capacitor discharge).

Below is a typical terminal diagram of a semi-conductor ignition system, the danger points are marked with red high-voltage arrows. We would point out that all semi-conductor ignition systems, even the older ones, are to be regarded as dangerous in the sense as defined by this bulletin.

Please address any queries or comments concerning the contents of this publication to our representative in your country.



Terminal diagram



# After-sales Service

## Technical Bulletin

Only for use within the Bosch organization. Not to be communicated to any third party.

EFFECTS OF ELECTRICAL AND ELECTRONIC  
SYSTEMS ON HEART PACEMAKERS

VDT-I-227/107 En

1.1981

e.g. ignition systems, Jetronic, Motronic, ABS

Please ensure without fail that this Bulletin is passed on to your employees for their attention!

We have often been asked by some of our customers whether or not patients with heart pacemakers are endangered in any way by ignition systems. This theme was recently the subject of an examination carried out by the Ignition System Development Department of Robert Bosch GmbH in conjunction with Dr. Thull, lecturer at the Central Institute for Biomedical Technology at the University of Erlangen-Nürnberg and Biotronic GmbH & Co. of Berlin, a manufacturer of heart pacemakers. The magazine "Biomedizinischen Technik" (5/80) listed the results.

The most important discoveries in this practice can be summarized from the examination report as follows:-

1. Heart pacemakers corresponding to the latest state of the art are not affected by radiation (electromagnetic fields) from ignition systems.
2. With a stationary engine and the ignition switched off the heart pacemaker is not affected by any part of the ignition system, even when unintentionally touched. Maintenance work in the engine compartment, for example, can then be carried out without any danger.
3. With the engine running or stationary with the ignition switched on, touching current-carrying parts of the ignition system, as well as parts of any other electrical system, presents a certain danger for everybody. The heart pacemaker can here be affected under certain conditions (voltage, current and frequency).  
Patients with heart pacemakers should therefore at all costs avoid touching current-carrying parts of electrical systems.
4. Furthermore, patients with heart pacemakers are more inclined to psychic shock effects than other people, even when they receive just a harmless electric shock, because many such patients are conscious of the increased danger to the cardiac activity.

We therefore consider it inadvisable for patients with heart pacemakers to be employed in workshops or on vehicles where ignition systems are being tested or repaired. If any members of your staff have heart pacemakers please carry out the necessary measures.

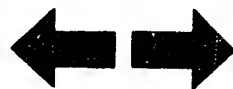
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We would like to add that heart pacemakers are not expected to be affected in any way by interference from other electronic products and systems which we manufacture, such as the Antiskid System (ABS), Jetronic, Motronic, because the much greater radiation intensity of the ignition systems examined in normal use has not caused any interference to heart pacemakers corresponding to the latest state of the art.

If you should receive questions on this matter from customers, please inform them accordingly.



# After-sales Service

## Technical Bulletin

Only for use within the Bosch organization. Not to be communicated to any third party.

NEW DESIGNATIONS FOR IGNITION SYSTEMS

VDT-I-227/108 En

1.1983

The introduction of new ignition systems has made it necessary to reclassify all designations.

The designations listed below will be used immediately in KH workshop and sales literature.

Designation	Abbrev'd code	Meaning	Switching	Ignition control and spark advance	High-voltage distribution
Coil ignition	SZ (CI)	-----	Mechanical (breaker points)	Mechanical (ignition distributor)	Mechanical (ignition distributor)
Transistorized coil ignition	TSZ-K (TCI-c)	K=breaker-triggered	Electronic (trigger box)	Mechanical (ignition distributor)	Mechanical (ignition distributor)
Trigger box with conventional circuit techniques	TSZ-I* (TCI-i)	I=Induction-type pulse generator	Electronic (trigger box)	Mechanical (ignition distributor)	Mechanical (ignition distributor)
	TSZ-H	H=Hall generator	Electronic (trigger box)	Mechanical (ignition distributor)	Mechanical (ignition distributor)
Transistorized ignition	TZ-I* (TI-i)	I=Induction-type pulse generator	Electronic (trigger box)	Mechanical (ignition distributor)	Mechanical (ignition distributor)
(Trigger box in Hybrid technique)	TZ-H* (TI-h)	H=Hall generator	Electronic (trigger box)	Mechanical (ignition distributor)	Mechanical (ignition distributor)



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